

EFFECT SALINITY STRESS ON 'N' UPTAKE BY SOYBEAN INOCULATED WITH SALT TOLERANT RHIZOBIUM UNDER *IN-VITRO* CONDITION

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ABSTRACT

The research work entitled, Effect salinity stress on 'N' uptake by soybean inoculated with salt tolerant Rhizobium under in-vitro condition" was carried out in the laboratory of Department of Plant Pathology and Agricultural Microbiology, Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2014-2017. The 'N' uptake of soybean was affected with increased EC levels of soil. A pot experiment was conducted with a view to seeing the effect of different EC levels of soil along with inoculation of a liquid formulation of salt tolerant Rhizobium on 'N' uptake by soybean. Five salinity levels of soil (1.5, 3, 4, 5 and 6 dSm⁻¹) were developed in pots. However, EC level 1.5 dSm⁻¹ i. e. absolute control shown better N uptake followed by EC level 3.0 dSm⁻¹ inoculated with salt tolerant Rhizobium (STR) over soybean crop inoculated with reference strain having EC level 1.5 dSm⁻¹ and EC level 3.0 dSm⁻¹. The lowest N uptake was recorded by uninoculated treatment of EC level 1.5 dSm⁻¹ i. e. absolute control and 3.0 dSm⁻¹. The N uptake was hampered at EC level 6.0 dSm⁻¹, inoculated with salt tolerant Rhizobium followed by inoculated reference strain at EC level 6.0 dSm⁻¹ and uninoculated treatment.

KEYWORDS: Salinity Stress, 'N' Uptake, Salt Tolerant Rhizobium, Soybean & Ec Levels

Received: Dec 01, 2018; **Accepted:** Dec 21, 2018; **Published:** Jan 05, 2019; **Paper Id.:** IJBRJUN20191

INTRODUCTION

Soil salinity decreased the nutrition uptake of plants, mineral nutritional status of plants greatly affects their ability to adapt to abiotic stresses. There was a considerable fall in the nitrogen fixation efficiency of mung bean under the saline environment (Balasubramaniam and Sinha 1976). Increasing salinity decreased the nodule number, fresh and dry weight of root and shoot, biomass, nitrogen percentage and nitrogen content in soybean (Dadras et al. 2012). Salinity has been reported to reduce total plant N in legumes such as chickpea (Lauter et al., 1981), soybean (Singleton and Bohlool, 1984) and faba bean (Yousef and Sprent, 1983); Zahran and Sprent, 1986). Feigin (1985) indicated that salinity reduced N uptakes/accumulation. The legumes are generally more sensitive to salt stress as compared to other crops and the productivity of all commercially useful legumes is reduced by saline conditions (Mass and Hoffman, 1976).

Rhizobium inoculation created a positive effect on nitrogen fixation remained significantly higher than the similar levels without inoculation (Nazir et al. 2002). Rhizobium strain effectively fixing N in saline and non-

saline conditions (Elsheikh, 1992). The ability of legume hosts to grow and survive in saline conditions was improved when they were inoculated with salt-tolerant strains of rhizobia (Zou et al., 1995; Hashem et al., 1998; Shamseldin and Werner, 2005). An efficient Rhizobium-legume symbiosis under salt stress required also the selection of salt-tolerant rhizobia (Zahran, 1999). The isolation of effective and salt-tolerant rhizobial strains, to be used as inoculum for the leguminous crop plants, could be an interesting strategy that may improve the adaptation, and the protection and yield of legumes under such stressful conditions (Benidire et al. 2017). Keeping in mind, salinity reclamation and nitrogen-fixing ability of salt tolerant Rhizobium the pot culture experiment was conducted.

MATERIAL AND METHODS

Five salinity levels using the mixture of NaCl and CaCl₂ (0.25Ca: Na on a molar basis) were used to give 1.5 (control), 3, 4, 5 and 6 dSm⁻¹. Soybean seeds were surface sterilized with 90 % alcohol were inoculated (with inoculums) with a liquid consortium of salt tolerant *Rhizobium* (10⁵- 10⁶ cfu g⁻¹ soil) and inoculated with reference strain salt tolerant Rhizobium. There was uninoculated (without inoculum) control treatment. The statistical analysis of data was carried out by employing Factorial Completely Randomized Design (FCRD) and Randomized Block Design (RBD). The critical differences were calculated at P = 0.01 level and P = 0.05 level of significance for the *in-vitro* experiments. Wherever F test was significant and interpretation of the results was carried out in accordance with Panse and Sukhatme (1967).

RESULTS

Effect of Seed Inoculation of Salt Tolerant Rhizobium along different EC Levels of soil on 'N' Uptake by Soybean Plant

'N' uptake by Plant

The 'N' uptake by soybean (Table 1; Figure 1) was affected as EC levels of soil increased. However significantly higher 'N' uptake was recorded by EC level 1.5 dSm⁻¹ i. e. absolute control (183.92 mg⁻¹ plant) followed by EC level 3.0 dSm⁻¹ (180.15 mg⁻¹ plant) inoculated with salt tolerant Rhizobium (STR) in soybean crop, inoculated with reference strain having EC level 1.5 dSm⁻¹ (178.14 mg⁻¹ plant) and EC level 3.0 dSm⁻¹ (174.82 mg⁻¹ plant). The lowest 'N' uptake was recorded by uninoculated treatment having EC level 1.5 dSm⁻¹ i. e. absolute (175.58 mg⁻¹ plant) control and 3.0 dSm⁻¹ (170.35 mg⁻¹ plant). The 'N' uptake was decreased at EC level 6.0 dSm⁻¹ (169.12 mg⁻¹ plant) inoculated with salt tolerant Rhizobium followed by inoculated reference strain at EC level 6.0 dSm⁻¹ (164.49 mg⁻¹ plant) and uninoculated treatment (158.21 mg⁻¹ plant).

Table 1: Effect of Seed Inoculation of Salt Tolerant Rhizobium along with different EC Levels of Soil on 'N' uptake of Soybean

Treatments	Treatment Details (EC dSm ⁻¹)	N uptake (mg ⁻¹ plant)			
		Inoculum With STR Consortium	Inoculum with Reference Strain	Without Inoculum	Mean
T ₁	1.5	183.92	178.14	175.58	179.21
T ₂	3	180.15	174.82	170.35	175.11
T ₃	4	176.41	171.66	166.26	171.44
T ₄	5	172.39	168.74	162.22	167.78
T ₅	6	169.12	164.49	158.21	163.94
Total		176.40	171.57	166.52	171.50
		Inoculum	EC levels	Inoculum × EC levels	
S. E. ±		0.045	0.029	0.100	
CD at 5 %		0.129	0.083	0.288	
CD at 1 %		0.174	0.137	0.388	

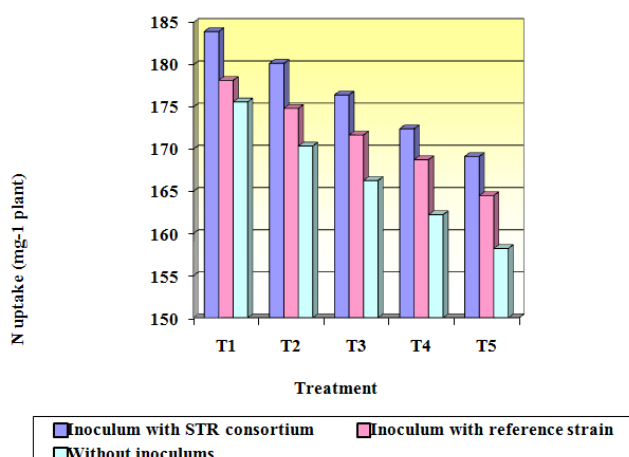


Figure 1: Effect of Seed Inoculation of Salt Tolerant Rhizobium along with different EC Levels of soil on 'N' Uptake of Soybean

DISCUSSIONS

The results are similar to Ahmad and Sindhu (1988) who reported that at different salinity levels i. e. control (1.5), 3.0, 6.0, 9.0 and 12.0 dSm⁻¹ soybean seeds were inoculated with an effective There was significant increase of nitrogen percentage in shoot and grain with increasing salinity levels, while total nitrogen per plant decreased significantly at elevated salinity. Inoculated plants contained more nitrogen than non-inoculated plants due to better nutrient availability.

Similarly, Nazir *et al.* (2002) studied the efficacy of *Rhizobium trifolii* in enhancing the salt tolerance of *Trifolium alexandrinum* (berseem or Egyptian clover) and reported Nitrogen percentage of berseem shoot and Percentage nitrogen of soil and nitrogen fixation in soil decreased consecutively with increase in salinity level while Rhizobium inoculation created a positive effect and these parameters remained significantly higher than the similar levels without inoculation.

Hatice *et al.* (2010) reported that N content of the plant and amounts of total and fixed N decreased progressively with increasing salinity levels. In both non-saline and saline (50 and 100 mM NaCl) conditions, inoculations with *Rhizobium leguminosarum* cv. *Ciceri* strains isolated from wild chickpeas significantly increased N content of the plant, and amounts of total and fixed N compared with the uninoculated control treatment, equal to or higher than standard culture and N application.

CONCLUSIONS

The area under soybean crop is increasing day by day also the land under soybean is also affected by salinity which ultimately resulted into low productivity of this crop. Therefore, it was thought worthwhile to isolate salt tolerant Rhizobium, which would be highly important inoculum to improve the growth and development of the leguminous plant under saline environment, it also included to access the diversity of salt tolerant *Rhizobium*.

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